

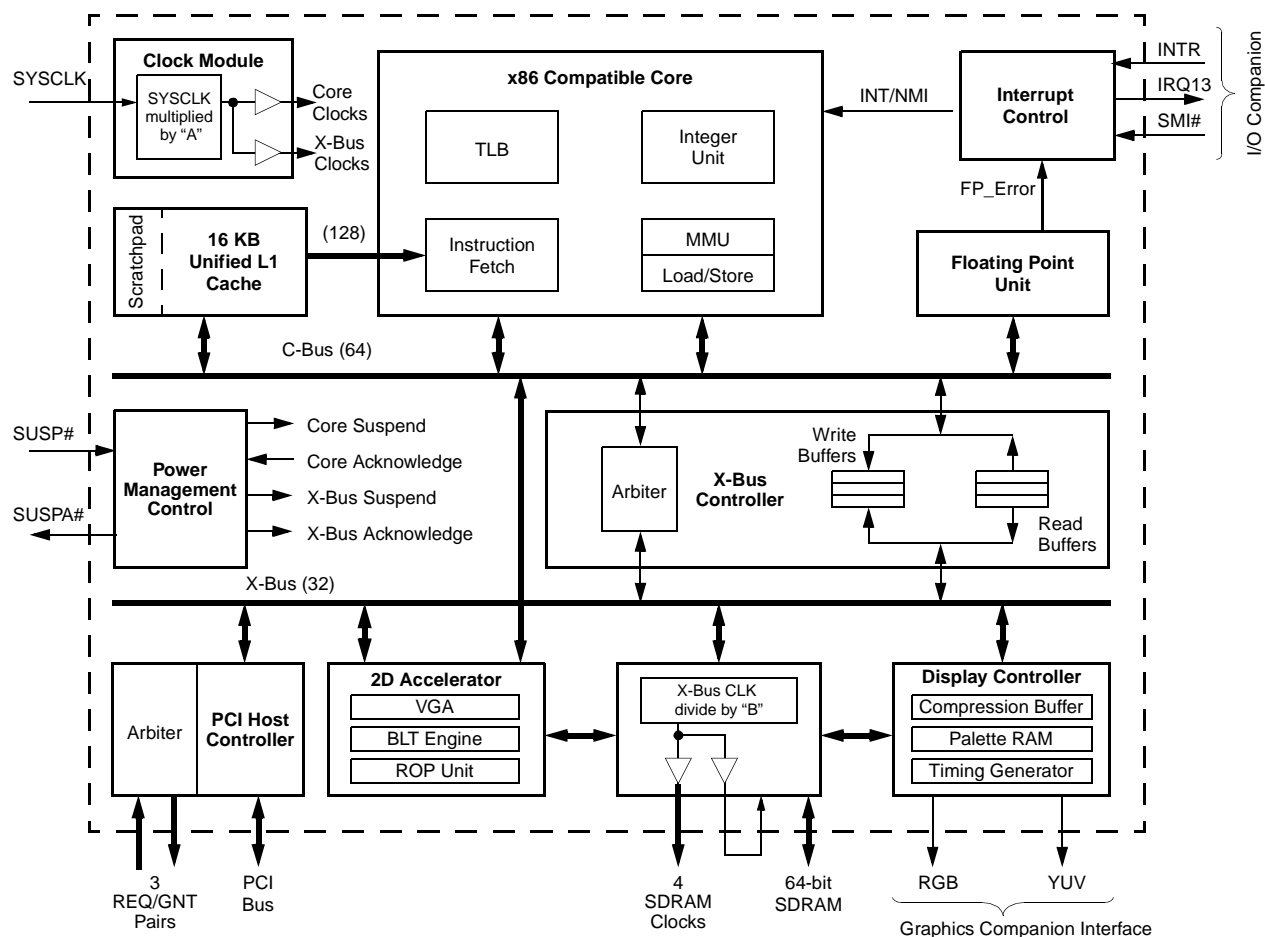
Geode™ GXLV Processor Series Low Power Integrated x86 Solutions

General Description

The National Semiconductor® Geode™ GXLV processor series is a line of integrated processors specifically designed to power information appliances for entertainment, education, and business. Serving the needs of consumers and business professionals alike, it's the perfect solution for I.A. (information appliance) applications such as thin clients, interactive set-top boxes, and personal internet access devices.

The Geode GXLV processor series is divided into three main categories as defined by the core operating voltage. Available with core voltages of 2.9V, 2.5V, and 2.2V, it offers extremely low typical power consumption (2.5W, 2.0W, and 1.5W respectively) leading to longer battery life and enabling small form-factor, fanless designs. Typical power consumption is defined as an average, measured running Windows® at 80% Active Idle (Suspend-on-Halt) with a display resolution of 800x600x8 bpp at 75 Hz.

Geode™ GXLV Processor Internal Block Diagram



While the x86 core provides maximum compatibility with the vast amount of Internet content available, the intelligent integration of several other functions, such as audio and graphics, offers a true system-level multimedia solution.

The Geode GXLV processor core is a proven x86 design that offers competitive performance. It contains integer and floating point execution units based on sixth-generation technology. The integer core contains a single, six-stage execution pipeline and offers advanced features such as operand forwarding, branch target buffers, and extensive write buffering. Accesses to the 16 KB write-back L1 cache are dynamically reordered to eliminate pipeline stalls when fetching operands.

In addition to the advanced CPU features, the GXLV processor integrates a host of functions typically implemented with external components. A full function graphics accelerator contains a VGA (video graphics array) controller, bitBLT engine, and a ROP (raster operations) unit for complete GUI acceleration under most operating systems. A display controller contains additional video buffering to enable >30 fps MPEG1 playback and video overlay when used with a National Semiconductor Geode I/O or Graphics Companion chip. Graphics and system memory accesses are supported by a tightly coupled SDRAM controller which eliminates the need for an external L2 cache. A PCI host controller supports up to three bus masters for additional connectivity and multimedia capabilities.

The GXLV processor also incorporates Virtual System Architecture™ (VSA™) technology. VSA technology enables the XpressGRAPHICS™ and XpressAUDIO™ subsystems. Software handlers are available that provide full compatibility for industry standard VGA and 16-bit audio functions that are transparent at the operating system level.

Together the National Semiconductor I/O Companion and the GXLV processor provide a scalable, flexible, low-power, system-level solution well suited for a wide array of information appliances ranging from hand-held personal information access devices to digital set-top boxes and thin clients.

Features

General Features

- Packaging:
 - 352-Terminal Ball Grid Array (BGA) or
 - 320-Pin Staggered Pin Grid Array (SPGA)
- 0.35-micron five layer metal CMOS process
- Split rail design
 - Available 2.2V, 2.5V, or 2.9V core
 - 3.3V I/O interface (5V tolerant)
- Low Typical Power Consumption
 - 1.0W @ 2.2V/166 MHz
 - 2.5W @ 2.9V/266 MHz

Note: Typical power consumption is defined as an average, measured running Windows at 80% Active Idle (Suspend-on-Halt) with a display resolution of 800x600x8 bpp @ 75 Hz. See "Performance Characteristics" on page 4 for further details

- Speeds offered up to 266 MHz
- Unified Memory Architecture
 - Frame buffer and video memory reside in main memory
 - Minimizes PCB area requirements
 - Reduces system cost
- Compatible with multiple I/O and Graphics Companion devices provided by National Semiconductor

32-Bit x86 Processor

- Supports the MMX™ instruction set extension for the acceleration of multimedia applications
- 16 KB unified L1 cache
- Six-stage pipelined integer unit
- Integrated Floating Point Unit (FPU)
- Memory Management Unit (MMU) adheres to standard paging mechanisms and optimizes code fetch performance:
 - Load-store reordering gives priority to memory reads
 - Memory-read bypassing eliminates unnecessary or redundant memory reads
- Re-entrant System Management Mode (SMM) enhanced for VSA technology

Flexible Power Management

- Supports a wide variety of standards:
 - APM for Legacy power management
 - ACPI for Windows power management
 - Direct support for all standard processor (C0-C4) states
 - OnNOW design initiative compliant
- Supports a wide variety of hardware and software controlled modes:
 - Fully Active
 - Active Idle (core-only stopped, display active)
 - Standby (core and all integrated functions halted)
 - Sleep (core and integrated functions halted and all external clocks stopped)
 - Suspend Modulation (automatic throttling of CPU core)
 - Programmable duty cycle for optimal performance/thermal balancing
 - Several dedicated and programmable wake-up events (via I/O or Graphics Companion chip)

PCI Host Controller

- Several arbitration schemes supported
- Supports up to three PCI bus masters
- Synchronous to CPU Core
- Allows external PCI master accesses to main memory concurrent with CPU accesses to L1 cache

Virtual Systems Architecture Technology

- Innovative architecture allowing OS independent (software) virtualization of hardware functions
- Provides XpressGRAPHICS subsystem
 - High performance legacy VGA core compatibility

Note: The GUI (Graphical User Interface) acceleration is pure hardware.
- Provides 16-bit XpressAUDIO subsystem
 - 16-bit stereo FM synthesis
 - OPL3 emulation
 - Supports MPU-401 MIDI interface
 - Hardware assist provided via I/O Companion chip
- Additional hardware functions can be supported as needed

2D Graphics Accelerator

- Accelerates BitBLTs, line draw, text
 - Bresenham vector engine

- Supports all 256 Microsoft®-defined Raster Operations (ROPs)
- Supports transparent BLTs and page flipping for DirectDraw®
- Runs at core clock frequency
- Full VGA and VESA mode support
- Special "driver level" instructions utilize internal scratchpad for enhanced performance

Display Controller

- Display Compression Technology (DCT) architecture greatly reduces memory bandwidth consumption of display refresh
- Supports a separate video buffer and data path to enable video acceleration in I/O and Graphics Companion chips
- Internal palette RAM for gamma correction
- Direct interface to I/O and Graphics Companion chips for CRT and TFT flat panel support eliminates the need for an external RAMDAC
- Hardware cursor
- Supports up to 1280x1024x8 bpp and 1024x768x16 bpp

XpressRAM™ Subsystem

- SDRAM interface tightly coupled to CPU core and graphics subsystem for maximum efficiency
- 64-Bit wide memory bus
- Support for:
 - Two 168-pin unbuffered DIMMs
 - Up to 16 simultaneously open banks
 - 16-byte reads (burst length of two)
 - Up to 256 MB total memory supported

Diverse Operating System Support

- Microsoft®: Windows® 2000, Windows 95, Windows 98, Windows NT®, and Windows CE
- Sun® Microsystems: Java™
- WindRiver®: VxWorks™
- QNX®: QNX®
- Linux™

Performance Characteristics

The Geode GXLV series of processors is designated by three core voltage specifications: 2.9V, 2.5V, and 2.2V. Each core voltage is offered in multiple frequencies that are enabled by specific system clock and internal multiplier settings. This allows the user to select the device(s) that best fit their power and performance requirements. This flexibility makes the GXLV processor series ideally suited for applications where power consumption and performance (speed) are equally important.

The following parts shown in the table below designate the various combinations of speed and power consumption available. Note that while there are three V_{CC2} (core) voltages available, the V_{CC3} (I/O) voltage remains constant at 3.3V (nominal) in order to maintain LVTTTL compatibility with external devices.

System Designs

As described previously, the GXLV series of integrated processors is specifically designed to work with other Geode I/O and Graphics Companion devices also provided by National Semiconductor. To help define and drive the emerging information appliance market, several reference systems have been developed by National Semiconductor. These GXLV processor-based reference systems provide optimized and targeted solutions for three main segments of the information appliance market: personal internet access, thin client, and set-top box. Contact your local National Semiconductor sales or field support representative for further information on reference designs, development platforms and manufacturing kits.

TABLE 1. GXLV Processor Performance Characteristics

Part Marking	Core Voltage (V _{CC2})	System Clock	Frequency Multiplier	Core Frequency	Maximum Power	Typical Power (Note) 80% Active Idle
GXLV-266P 2.9V 70C	2.9V (Nominal)	33 MHz	x8	266 MHz	7.8W	2.50W
GXLV-266P 2.9V 85C						
GXLV-266B 2.9V 70C						
GXLV-266B 2.9V 85C						
GXLV-233P 2.5V 85C	2.5V (Nominal)	33 MHz	x7	233 MHz	5.6W	2.0W
GXLV-233B 2.5V 85C						
GXLV-200P 2.2V 85C	2.2V (Nominal)	33 MHz	x6	200 MHz	4.1W	1.5W
GXLV-200B 2.2V 85C						
GXLV-180P 2.2V 85C		30 MHz	x6	180 MHz	3.9W	1.25W
GXLV-180B 2.2V 85C						
GXLV-166P 2.2V 85C		33 MHz	x5	166 MHz	3.7W	1.0W
GXLV-166B 2.2V 85C						
Note: Typical power consumption is defined as an average measured running Windows at 80% Active Idle (Suspend-on-Halt) with a display resolution of 800x600x8 bpp at 75 Hz.						

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